LEACHATE TREATMENT TECHNOLOGIES

PETE A. SHACK, P.E., CHMM

(615)263-5555

Phoenix
ENVIRONMENTAL ENGINEERS, INC.

WHAT IS LEACHATE?

- WEBSTERS: A SOLUTION OR PRODUCT OBTAINED BY PASSING A LIQUID THROUGH A SUBSTANCE.
- WIKIPEDIA: ANY LIQUID THAT, IN THE COURSE OF PASSING THROUGH MATTER, EXTRACTS SOLUBLE OR SUSPENDED SOLIDS, OR ANY OTHER COMPONENT OF THE MATERIAL THROUGH WHICH IT HAS PASSED.
- MINE: SOUP OF THAT IS COOKED UP IN THE LANDFILL MADE UP OF WASTES PLUS DEGRADATION PRODUCTS.

LEACHATE CONTAINS

- DISSOLVED CHEMICALS
  - SALTS, METALS
  - DECOMPOSITION BYPRODUCTS
  - INDUSTRIAL WASTE
  - HOUSEHOLD HAZARDOUS WASTE
- SOLIDS
  - SOIL AND GRIT
  - COLLOIDAL MATTER
  - BACTERIA

CHARACTERISTICS

- VARIES WIDELY
- BASED ON WHAT IS IN LANDFILL
- AMOUNT OF RAINFALL
- DEPTH OF LANDFILL
- AGE OF LANDFILL
- TYPE OF COVER

EFFECT OF AGE ON LEACHATE

Parameter	LANDFILL AGE		
	1-5 yrs	5-10 yrs	>10 yrs
BOD, mg/L	500 - 3,000	400 - 3,000	<400
COD, mg/L	1,200 - 8,000	4,000-10,000	<4,000
TKN, mg/L	100 - 1000	20 - 200	<50
NH_4-N, mg/L	50 - 500	200 - 500	<50
Organic Content	80% VFA	5 – 30% VFA+Humic/Fluvic Acids	Humic/Fulvic Acids
Metals	Low-Med	Low	Low
TDS, mg/L	4,000 – 9,000	2,000 – 6,000	<5,000
pH	4.5 - 6.5	6.5-7.5	>7.5

~~TYPICAL~~ MSW LEACHATE

Parameter	Average
BOD, mg/L	400 – 3,000
COD, mg/L	1,500 – 10,000
TDS, mg/L	4,000 – 9,000
NH_4-N, mg/L	100 – 800
pH, SU	5.0 – 7.5

MSW WITH SMELTING WASTE

Parameter	Average
BOD, mg/L	400 – 3,000
COD, mg/L	1,900 – 10,000
TDS, mg/L	10,000 – 75,000
NH_4-N, mg/L	700 – 3,500
pH	7.5 – 8.5

MSW WITH WASTEWATER SLUDGE

Parameter	Average
BOD, mg/L	750 – 6,000
COD, mg/L	1,500 – 10,000
TDS, mg/L	5,000 – 15,000
NH_4-N, mg/L	500 – 1,500
pH	6.5 – 7.5

ULTIMATE DISPOSAL OPTIONS/COSTS

• HAULING TO TREATMENT PLANT (POTW)	$0.10 - $0.50/GAL
• PRETREATMENT	$0.05 - $0.25/GAL
• DISCHARGE VIA NPDES PERMIT	$0.005 - $0.03/GAL
• LAND APPLICATION	$0.005 - $0.10/GAL

TYPES OF TREATMENT TECHNOLOGIES

- PHYSICAL
- CHEMICAL
- BIOLOGICAL

PHYSICAL TREATMENT
(SEPARATION TECHNOLOGIES)

- SEDIMENTATION
  - HOLDING POND
- EVAPORATION
  - SPRAYING
  - HEATING
- AIR STRIPPING
- FILTRATION
  - GRANULAR MEDIA
  - ULTRAFILTRATION
  - REVERSE OSMOSIS
- ADSORPTION
  - CARBON
  - ION EXCHANGE

SEDIMENTATION

EVAPORATION

COURTESY OF TUSLIMLINE MANUFACTURING, LTD.

COURTESY OF HEARTLAND TECHNOLOGY, LLC.

AIR STRIPPING

FILTRATION

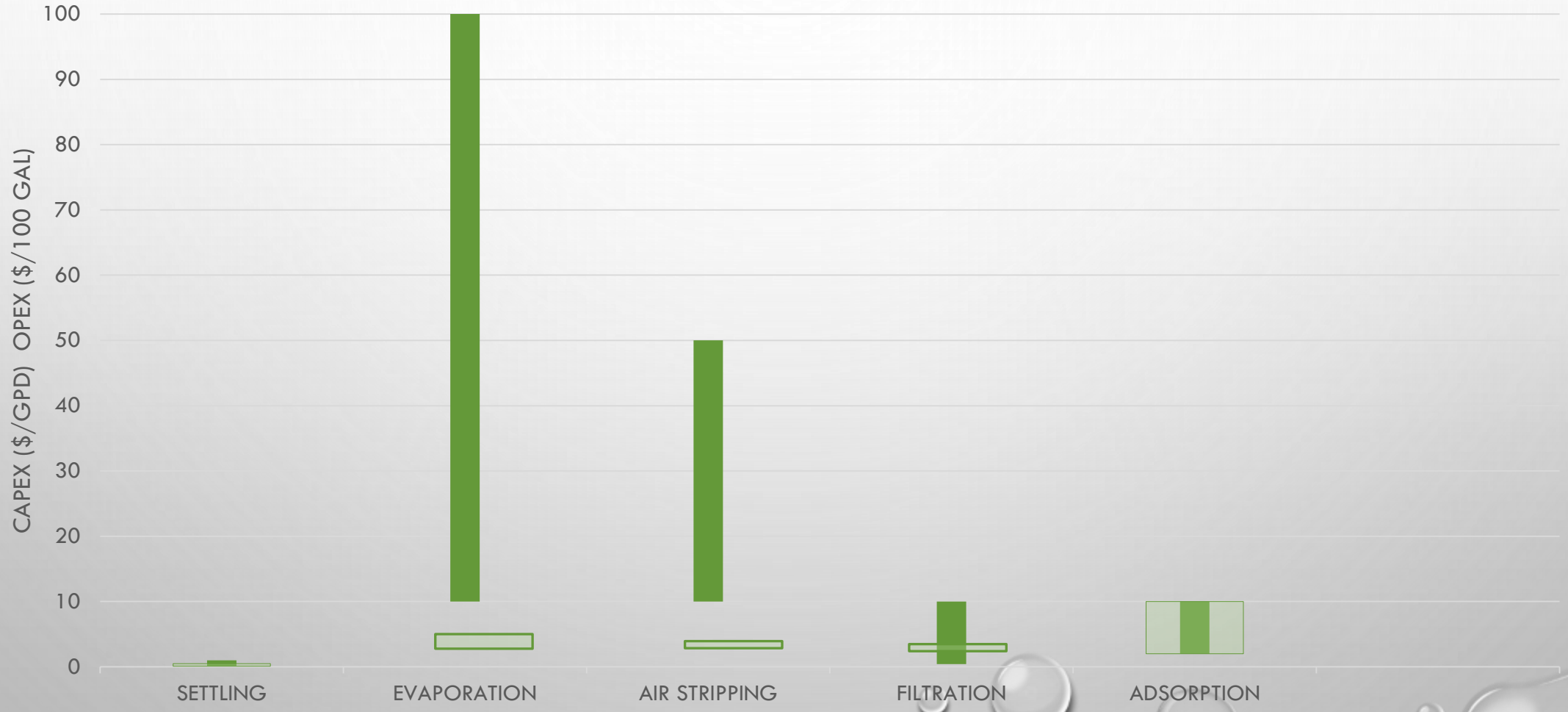
COURTESY OF DYNATECH SYSTEMS, INC.

ADSORPTION

PHYSICAL TREATMENT COSTS

	CAPITAL ($/GPD)	OPERATING ($/GAL)
SETTLING	0.1-1.0	0.001-0.005
EVAPORATION	10-100	0.005-0.03
AIR STRIPPING	10-50	0.001-0.01
FILTRATION	0.4-10	0.001-0.01
ADSORPTION	2-10	0.02-0.10

PHYSICAL TREATMENT COST COMPARISON

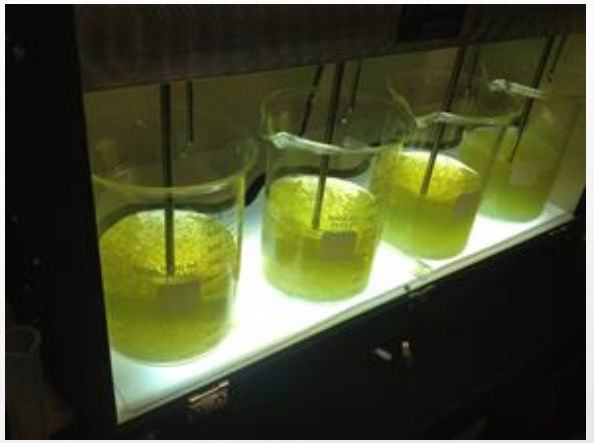


CHEMICAL TREATMENT

- PH ADJUSTMENT
- SEPARATION TECHNOLOGIES
  - COAGULATION
  - METALS PRECIPITATION
    - HYDROXIDE
    - SULFIDE
  - AMMONIA STRIPPING
  - ELECTROCOAGULATION
- CHEMICAL OXIDATION TECHNOLOGIES
  - CHLORINATION
  - OZONE/UV
  - HYDROGEN PEROXIDE
  - PERMANGANATE
  - CHLORINE DIOXIDE

PH ADJUSTMENT

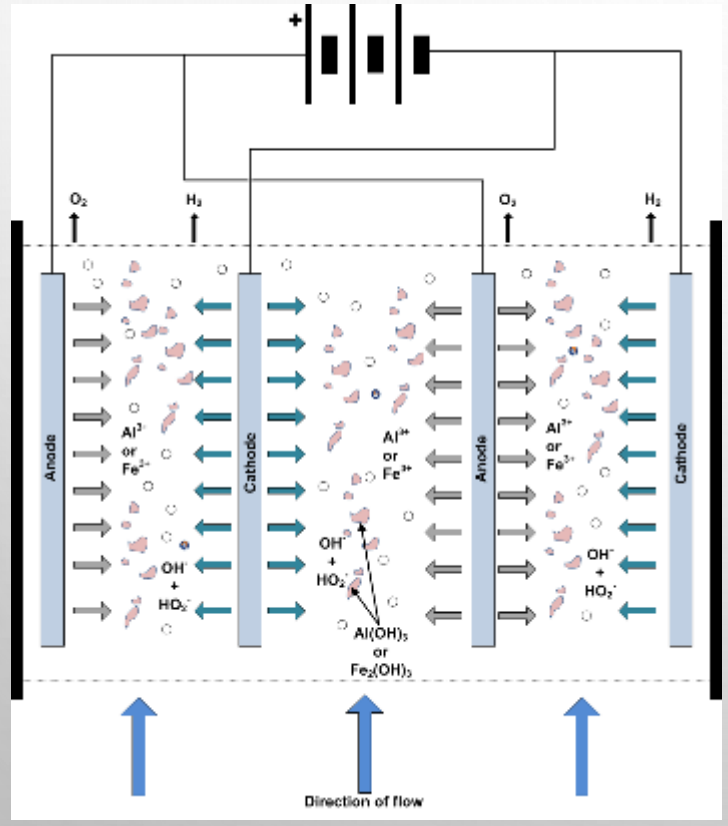
COAGULATION



METALS PRECIPITATION

AMMONIA STRIPPING

ELECTROCOAGULATION



COURTESY OF F&T WATER SOLUTIONS

CHEMICAL OXIDATION

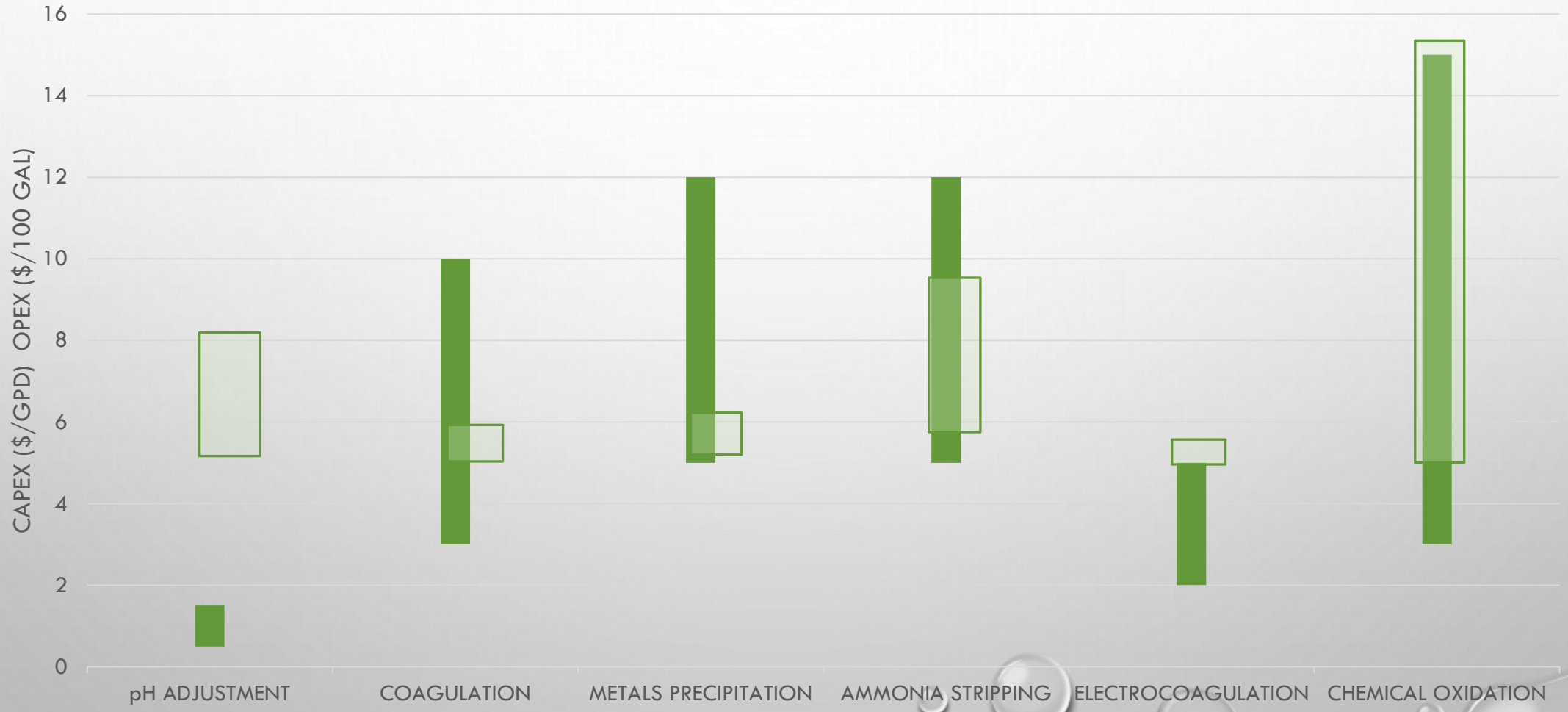
- COMMON OXIDANTS
  - BLEACH
  - HYDROGEN PEROXIDE
  - FENTONS REAGENT
  - OZONE
  - CHLORINE DIOXIDE

COURTESY OF LENNTECH

CHEMICAL TREATMENT COSTS

	CAPITAL ($/GPD)	OPERATING ($/GAL)
pH ADJUSTMENT	0.5-1.50	0.005-0.05
COAGULATION	3-10	0.003-0.015
METALS PRECIPITATION	5-12	0.005-0.02
AMMONIA STRIPPING	5-12	0.015-0.07
ELECTROCOAGULATION	2-5	0.001-0.01
CHEMICAL OXIDATION	3-15	0.003-0.15

CHEMICAL TREATMENT COST COMPARISON

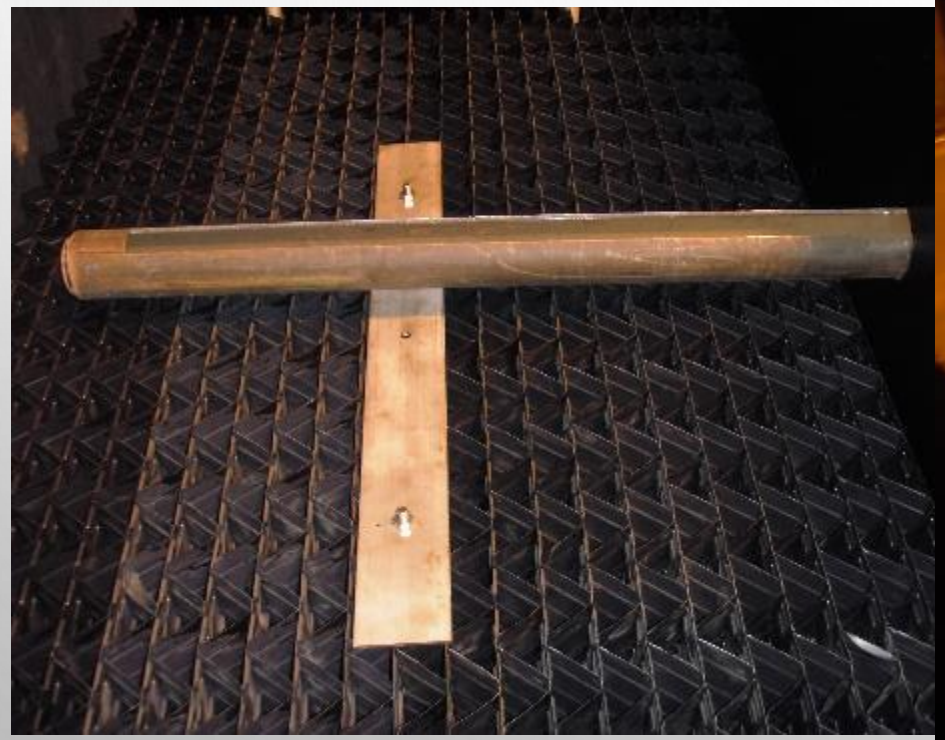


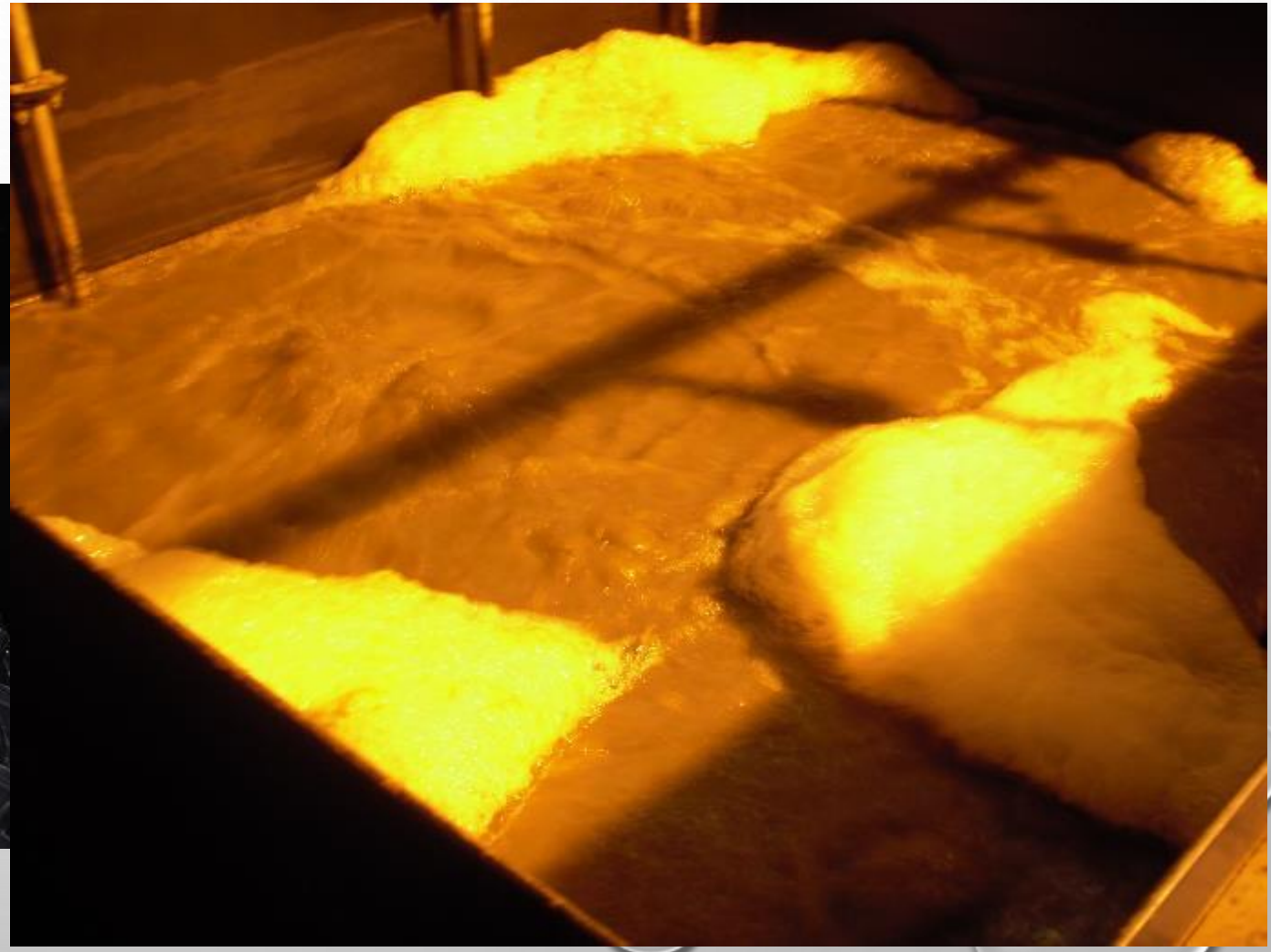
BIOLOGICAL TREATMENT

- FIXED FILM
  - FIXED BED
  - MOVING BED
- BIOREACTOR LANDFILL
- ARTIFICIAL WETLANDS

- ACTIVATED SLUDGE
  - CONVENTIONAL
  - SBR
  - MBR
- NITRIFICATION
- DENITRIFICATION

FIXED FILM

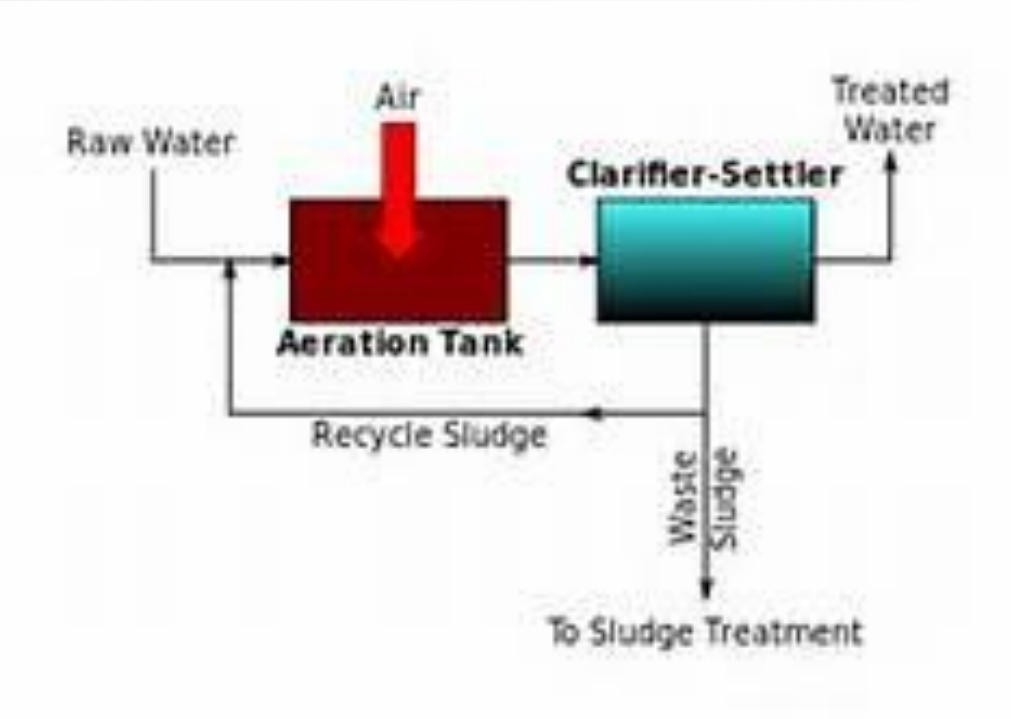




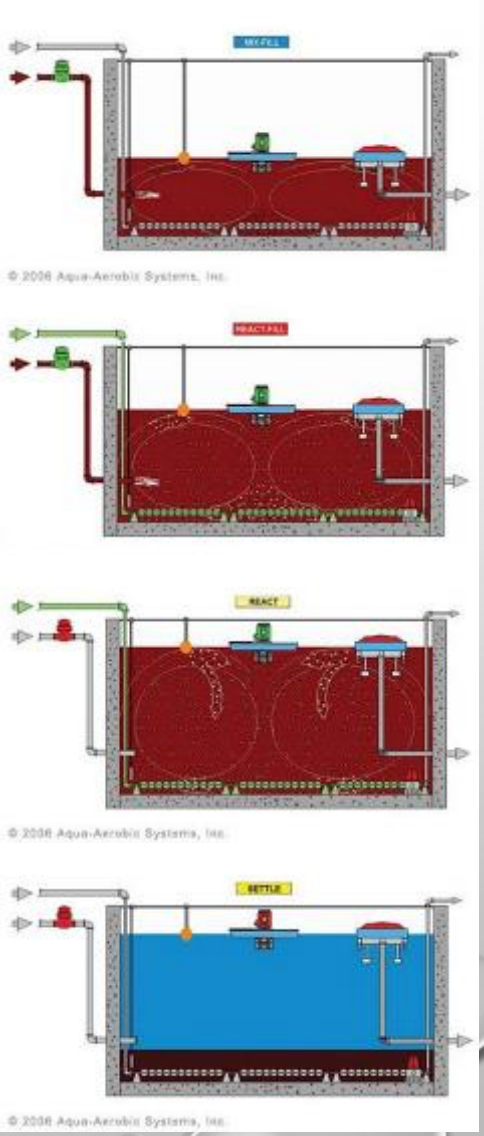
BIOREACTOR LANDFILL

ARTIFICIAL WETLAND

CONVENTIONAL ACTIVATED SLUDGE



SEQUENCING BATCH REACTOR



MEMBRANE BIOREACTOR

NITROGEN TREATMENTS

- NITRIFICATION

AMMONIA + OXYGEN + ALKALINITY + NITRIFIERS → S + WATER + MORE NITRIFIERS

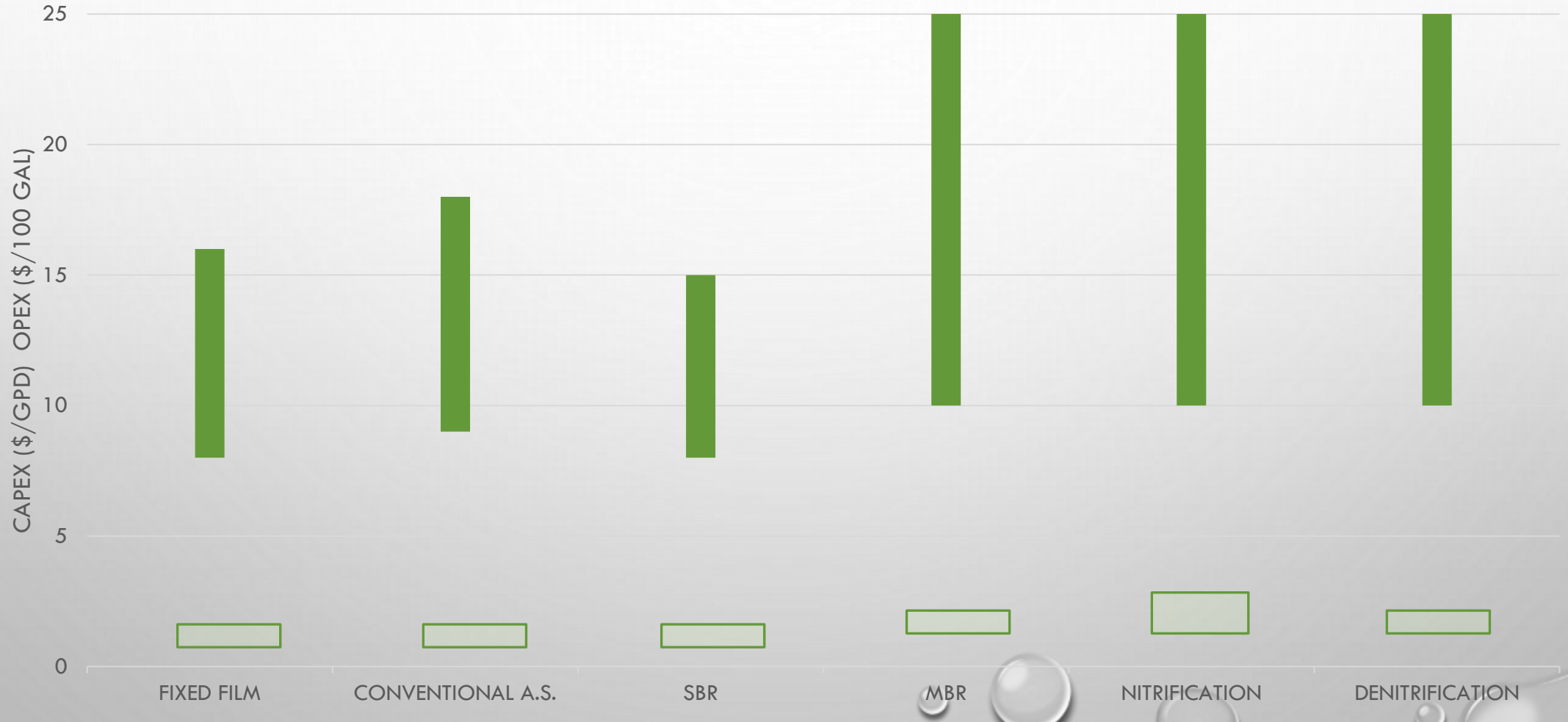
- DENITRIFICATION

NITRATES + ORGANICS + BACTERIA → OGEN GAS + WATER + ALKALINITY + MORE BACTERIA

BIOLOGICAL TREATMENT COSTS

	CAPITAL ($/GPD)	OPERATING ($/GAL)
FIXED FILM	8–16	0.002-0.01
CONV. ACTIVATED SLUDGE	9-18	0.003-0.01
SBR	8-15	0.003-0.01
MBR	10-25	0.005-0.015
NITRIFICATION	10-25	0.007-0.02
DENITRIFICATION	10-25	0.005-0.015

BIOLOGICAL TREATMENT COST COMPARISON



TAKEAWAYS

1. THERE ARE MANY OPTIONS FOR LEACHATE TREATMENT.
2. LEACHATE TREATMENT SELECTION IS HIGHLY DEPENDENT UPON LEACHATE CHARACTERISTICS AND DISPOSAL REQUIREMENTS (SITE-SPECIFIC).
3. SOME LEACHATES ARE VERY CHALLENGING TO TREAT COST-EFFECTIVELY.
4. IT IS DIFFICULT AND RISKY TO BASE LEACHATE TREATMENT SELECTION WITH COST AS THE MAIN OR ONLY DRIVER.